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PROVISIONAL INTELLIGENCE REPORT

SUPPLY OF ENERGY IN THE USSR 1940-60

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S-E-C-R-E-T

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(ORR Project 20.832)

NOTICE

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CENTRAL INTELLIGENCE AGENCY

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FOREWORD

This report presents estimates of the supply of energy available to the national economies of the USSR and the US in 1940, 1945, 1950, 1955, and 1960. The rate of growth of the Soviet supply of energy during 1940-60 is compared with that of the US; changes in the structure of the supply of energy in each country during 1940-60 are noted; and the amount of energy available per worker in the civilian labor force of the USSR is estimated for 1950, 1955, and 1960 and compared with the amount available in the US in the same years. The estimated rate of growth of the Soviet supply of energy is compared with the estimated rate of growth of Soviet industrial production in 1951-60. Estimates of the regional distribution of production of energy in the USSR in 1955 are also presented.

This report is the first to be published by CIA on the combined supply of solid fuels, petroleum components and products, and hydroelectric power in the USSR. Because of its preliminary nature, this report includes estimates of only the volume, weight, and energy content of the sources of energy produced and traded. Questions of quality, cost, and price are to be discussed in future reports.

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SUPPLY OF ENERGY IN THE USSR*
1940-60

Summary

The supply of energy** in the USSR has grown rapidly since World War II. By 1950 the supply of energy had increased to 340 million metric tons*** of standard fuel, a gain of 70 percent above that in 1945. By the end of the Fifth Five Year Plan (1951-55) the supply of energy had increased 50 percent above that in 1950. The Sixth Five Year Plan (1956-60) provides for the supply of energy in 1960 to reach 810 million tons of standard fuel, an increase of 59 percent above that in 1955. This rapid rate of growth has caused the ratio of the supply of energy in the US to that in the USSR to decrease from 5.3 to 1 in 1945 to 3.4 to 1 in 1950 and to 2.7 to 1 in 1955. If the Sixth Five Year Plan directives concerning domestic production of primary energy are fulfilled, the ratio of the supply of energy anticipated in the US to that planned in the USSR will be 2.2 to 1 in 1960.

Solid fuels have contributed the major part of the supply of energy in the USSR through 1955 and will continue to do so through 1960. Energy from petroleum (including natural gas) has been contributing an increasing share of the supply. Although petroleum accounted for only 20 percent of the supply in 1955, it will account for an estimated 28 percent of the supply in 1960. Production of hydroelectric power in the USSR has also increased but has furnished only a minor percentage of the supply of energy. Hydroelectric power probably will furnish only an estimated 3.6 percent of the supply in 1960.

By 1960 the USSR plans to eliminate the periodic shortages of energy which have been experienced in recent years and to increase state fuel reserves. The Sixth Five Year Plan also provides for a more

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 March 1957.

** Definitions of the terms supply of energy and standard fuel and other terms used in this report are given in I, B, pp. 3-5, below.

*** Tonnages are given in metric tons throughout this report.

proportionate increase between the supply of energy and industrial production. Present Soviet plans call for the supply of energy to increase by 59 percent during 1956-60 and for Soviet industrial production to increase concomitantly by only 65 percent, whereas a 50-percent increase in the Soviet supply of energy during 1951-55 supported a 76-percent increase in Soviet industrial production.

The energy available per worker in the civilian labor force of the USSR rose from 3.8 tons of standard fuel in 1950 to 5.1 tons in 1955 and may reach 7.4 tons in 1960. Compared with US workers, however, Soviet civilian workers are poorly supported with inanimate energy. The ratio of the energy available per civilian worker in the US to the energy available per civilian worker in the USSR dropped from 5.0 to 1 in 1950 to 4.1 to 1 in 1955 and may decrease further to 3.5 to 1 in 1960.

Solid fuels constituted the major part of production of primary energy in every economic region* of the USSR except the Transcaucasus (Region V) and the Volga (Region VI), where the major production of primary energy occurred in the form of crude oil. Hydroelectric power was insignificant in total production of primary energy in every region.

I. Introduction.

A. General.

A knowledge of the pattern of supply of all types of energy is needed to estimate the economic capabilities, vulnerabilities, and intentions of any country. Data on the supply and the cost of solid fuels, petroleum components and products, and electric power are essential to such estimates.

* The term region in this report refers to the economic regions defined and numbered on CIA Map 13702 (4-55), USSR: Administrative Divisions and Economic Regions, January 1955.

B. Definition of Terms.

The term supply of energy as used in this report refers to the amount of energy available to a country in any year as the net result of both domestic production of primary sources of energy and foreign trade in both primary and secondary energy.

The term primary source of energy refers to a source of energy which is extracted directly from its natural place of occurrence, such as minerals, growth in the earth, or falling water. The term primary energy is frequently used to refer to the energy contained in one or more primary sources of energy.

The term secondary source of energy refers to a source of energy which is derived by the further processing of a primary source. The term secondary energy is frequently used to refer to the energy contained in one or more secondary sources of energy.

The term standard fuel refers to a measure adopted by Soviet authorities for the purpose of comparing fuels on the basis of their calorific values. Standard fuel has been assigned a calorific value of 7,000 kilocalories per kilogram (kc/kg).

The term solid fuels applies either to primary or to secondary fuels, or to both. Coal, peat, oil shale, and fuelwood are primary solid fuels. Coke and fuel briquettes are secondary solid fuels which are considered in this report.

Coal is a complex product of nature, formed by the decomposition of vegetation under the influence of moisture, heat, and pressure for millions of years. The inherent physical and chemical properties of different types of coal vary widely. The USSR produces coals of all types, ranging from superior quality anthracite to the lowest quality lignite, or brown coal.

The term hard coal is used by the USSR to refer to either anthracite or bituminous coal, or to both.* Following Soviet usage, the term hard coal is used in this report to refer either to Soviet anthracite, which is characterized by a volatile content of 3 to 5 percent, or to Soviet bituminous coals, which are classified according

* In the US, hard coal refers to anthracite only.

to volatile content and which range from lean coals with a volatile content of less than 17 percent to those known as long-flame coals with a volatile content as high as 44 percent.

Lignite, or brown coal, is a noncaking, usually brownish-black type of coal which is intermediate in calorific value between hard coal with a higher calorific value and peat with a lower calorific value.

Peat is semicarbonized vegetable matter formed by partial decomposition in water of various plants, especially certain mosses. Peat has a very high moisture content (usually 85 percent or more in the peat bog) and must be dried before it can be used for fuel. The estimates given in this report are for dried peat produced for fuel and do not include the large amount of peat used in the USSR for agricultural purposes.

Oil shales are sedimentary rocks containing enough carbonaceous material to make economically feasible their use either as a primary solid fuel or as sources of shale oil or shale gas. The calorific value of oil shale is relatively low, although it is higher than some of the poorest coal now produced in the USSR.

Fuelwood is wood cut or shaped for use as firewood, primarily for household use, but also for space heating and production of steam in small industrial installations.

Petroleum is "a material occurring naturally in the earth which is predominantly composed of mixtures of chemical compounds of carbon and hydrogen with or without other nonmetallic elements such as sulfur, oxygen, nitrogen, etc. Petroleum may contain, or be composed of, such compounds in a gaseous, liquid, and/or solid state, depending on the nature of these compounds and the existent conditions of temperature and pressure." 1/* The term petroleum component refers to any of the following: natural crude oil, asphalt, wet natural gas, dry natural gas, and natural gas liquids (natural gasoline, liquefied petroleum gas, and others).

* For serially numbered source references, see Appendix F.

Crude oil refers to natural crude oil only. Natural crude oil refers to "that liquid component of petroleum separated at or near the well and stabilized at atmospheric pressure and temperature." 2/

Natural gas liquids, which are recovered from natural gas, are "those hydrocarbon liquids which are gaseous or in solution with crude oil in the reservoir and which are recoverable as liquids by the processes of condensation, absorption, or adsorption which take place in field separators, scrubbers, gasoline plants, or cycling plants." 3/

Natural gas is "that component of petroleum which is stabilized in gaseous form for pipeline transportation from the oil or gas field or petroleum-producing area." 4/

Petroleum products are the useful products derived from natural and synthetic petroleum in forms suitable for final consumption. 5/

C. Conversion Factors.

Conversion factors peculiar to the preparation of the estimates in this report and the sources from which they were taken are given in the footnotes to the tables in which they are used. Other factors used in preparing this report are given in this section.

For the ordinary type of conversion factors necessary to this report, the sources listed under 6/ were especially valuable.

The calorific value of the various types of solid fuels produced or traded by the USSR in all the years covered by this report, with one exception, has been calculated as follows:

Type of Solid Fuel	Kilocalories per Kilogram
Hard coal	
Produced	6,650
Exported	6,650
Imported	6,030

Type of Solid Fuel (Continued)	Kilocalories per Kilogram (Continued)
Lignite produced	3,580
Peat produced	2,630
Oil shale produced	2,060
Coke	
Exported	6,510
Imported	6,000
Fuel briquettes imported	4,700

The one exception to the above figures is the conversion factor used for imports of hard coal. The value listed above was used for 1955 only. The value used for 1945 was 6,000 kc/kg.*

Estimates of production of fuelwood in million cubic meters were converted into tons of standard fuel on the basis of a calorific value of 1.3 million kc per cubic meter. 7/

A calorific value of 1.41 tons of standard fuel per ton was used for both Soviet and US crude oil.**

The calorific value of Soviet natural gas was given in a 1946 Soviet publication. 8/ Accordingly, each 1,000 cubic meters of Soviet natural gas has been considered to be equivalent to 1.20 tons of standard fuel.

A factor of 1.5 tons of standard fuel (or 43 million British thermal units -- Btu) per ton was used for the average calorific value of any quantity of mixed petroleum products because this factor can be so used without introducing a maximum error of more than 10 percent. 9/

* See Table 10, p. 25, below.
** For methodology, see Appendix D.

Hydroelectric power usually can be converted with greater technical efficiency into useful heat or power than can most other types of primary energy. The significance of hydroelectric power in the total production of primary energy in any area is, therefore, understated when each of the primary fuels under consideration is measured in terms of its calorific value at the point of production. One of two methods ordinarily is used in estimating the calorific value of hydroelectric power at the point of production. First, each kilowatt-hour (kwh) of hydroelectric power may be stated in terms of the theoretical equivalent of that kwh in terms of standard fuel. Second, the kwh may be equated to the amount of energy contained in the average amount of another fuel, such as coal, which is consumed by the average thermal power station in producing a kwh of electric power. The second method has been used in this report because it involves only a simple, relatively precise methodology and tends to minimize the understatement of the significance of hydroelectric power.

D. Reasons for the Use of a Particular Common Unit of Energy.

Any one of several common units can be used to define the energy content of the different types of fuel. Kilowatt-hours, horsepower-hours, calories, ergs, or British thermal units serve equally well as common denominators.

The energy content of various types of fuel is expressed in this report in units of standard fuel in order that the figures given may be more readily compared with statistics in other reports on energy. Previous ORR reports on solid fuels in the Sino-Soviet Bloc and National Intelligence Surveys have used the unit of standard fuel. The World Power Conference, the Statistical Office of the UN, and the Organization for European Economic Cooperation (OEEC) use the unit of a hard coal equivalent, which is similar to the unit of standard fuel. In fact, when the hard coal equivalent is adopted as having a calorific value of 7,000 kc/kg, it is identical to a unit of standard fuel. Because Soviet economists express data on the supply of energy in units of standard fuel, data expressed in units of standard fuel in this report should be readily comparable with statistics appearing in

publications of the intelligence community, in statistical compilations of those international organizations mentioned above, and in primary source material on the Sino-Soviet Bloc.

Data given in Tables 1, 2, and 4,* however, are given in both units of standard fuel and British thermal units. The data in British thermal units were incorporated in these summary tables in order that the figures might quickly be compared with US and UK statistics on energy, which generally are expressed in British thermal units.

II. Supply of Energy in the USSR and in the US.

The supply of energy in the USSR and that in the US in selected years, 1940-60, are shown in Tables 1 and 2,** respectively. For purposes of comparison, the magnitude and structure of the apparent supply of energy in the USSR and the US in selected years, 1940-60, are shown in Figure 1.*** Foreign trade in both primary and secondary energy is of little consequence to the total supply of energy either in the USSR or in the US.****

A. Rate of Growth.

The supply of energy in the USSR dropped during World War II from 250 million tons of standard fuel in 1940 to 200 million tons, 80 percent of the 1940 level, in 1945. During the Fourth Five Year Plan (1946-50) period the supply of energy increased 70 percent above that in 1945. During the Fifth Five Year Plan (1951-55) period the increase was 50 percent above that in 1950. Soviet plans for 1960 provide for an increase of 59 percent above the supply in 1955, to 810 million tons of standard fuel.

In the US the supply of energy rose by 24 percent during World War II, from 890 million tons of standard fuel in 1940 to 1,100 million tons of standard fuel in 1945. From 1945 to 1950 it increased by only

* Pp. 9, 10, and 16, respectively, below.
** Tables 1 and 2 follow on pp. 9 and 10, respectively, below.
*** Following p. 10.
**** For more detailed statistical data on both Soviet and US production of and trade in solid fuels, petroleum components and products, and hydroelectric power, see Appendixes A, B, and C.

Table 1

Estimated Supply of Energy in the USSR a/ Selected Years, 1940-60

Year	Factors Affecting Supply	Solid Fuels: Million Metric Tons of Standard Fuel c/	Solid Fuels: Trillion Btu d/	Solid Fuels: Percent of Total Supply	Petroleum Fuels: Million Metric Tons of Standard Fuel c/	Petroleum Fuels: Trillion Btu d/	Petroleum Fuels: Percent of Total Supply	Hydroelectric Power b/: Million Metric Tons of Standard Fuel	Hydroelectric Power b/: Trillion Btu d/	Hydroelectric Power b/: Percent of Total Supply	Total: Million Metric Tons of Standard Fuel	Total: Trillion Btu d/	Total: Percent of Total Supply
1940	Production	200	5,600	80	47	1,300	19	2.6	71	1.0	250	6,900	100
	Imports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Exports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Supply of energy	200	5,600	80	47	1,300	19	2.6	71	1.0	250	6,900	100
1945	Production	170	4,600	83	31	860	16	2.4	67	1.2	200	5,500	100
	Imports	4.5	130	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Exports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Supply of energy	170	4,700	84	31	860	15	2.4	67	1.2	200	5,600	100
1950	Production	270	7,400	80	59	1,600	18	6.4	180	1.9	330	9,100	100
	Imports	9.3	260	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Exports	0.43	12	N.A.	N.A.	N.A.	N.A.	0	0	0	N.A.	N.A.	N.A.
	Supply of energy	280	7,700	81	59	1,600	17	6.4	180	1.9	340	9,300	100
1955	Production	380	11,000	76	110	3,100	22	12	320	2.3	500	14,000	100
	Imports	9.6	270	59	6.6	180	41	0	0	0	16	450	100
	Exports	2.4	67	26	6.7	190	74	0	0	0	9.1	250	100
	Supply of energy	390	11,000	76	110	3,100	22	12	320	2.3	510	14,000	100
1960	Production	550	15,000	68	230	6,400	28	30	820	3.6	810	22,000	100
	Imports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Exports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Supply of energy	550	15,000	68	230	6,400	28	30	820	3.6	810	22,000	100

a. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. The energy content of hydroelectric power has been equated to the energy content of the average amount of coal consumed in the USSR in 1955 in producing 1,000 kilowatt-hours (kwh) of electricity at thermal power stations, or 0.50 ton of standard fuel per 1,000 kwh. 10/ It is recognized, however, that the fuel-consumption rate per kwh in the USSR has shown a continual downward trend during the 1940-55 period. Figures in this column were derived from those given in Table 20, p. 37, below.
c. Figures in this column were taken from Tables 5, 10, and 11, pp. 19, 25, and 26, respectively, below.
d. British thermal units. Each figure in this column was derived from the figure immediately to the left of it on the same line by use of a conversion factor of 27,780,000 Btu per ton of standard fuel.
e. Figures in this column were taken from Tables 14 and 17, pp. 31 and 34, respectively, below.

Table 2

Estimated Supply of Energy in the US a/
Selected Years, 1940-60

Year	Factors Affecting Supply	Solid Fuels: Million Metric Tons of Standard Fuel c/	Solid Fuels: Trillion Btu d/	Solid Fuels: Percent of Total Supply	Petroleum Fuels: Million Metric Tons of Standard Fuel c/	Petroleum Fuels: Trillion Btu d/	Petroleum Fuels: Percent of Total Supply	Hydroelectric Power b/: Million Metric Tons of Standard Fuel	Hydroelectric Power b/: Trillion Btu d/	Hydroelectric Power b/: Percent of Total Supply	Total: Million Metric Tons of Standard Fuel	Total: Trillion Btu d/	Total: Percent of Total Supply
1940	Production	490	14,000	55	380	11,000	43	22	610	2.5	890	25,000	100
	Imports	0.47	13	2.8	16	450	97	Negligible	Negligible	Negligible	17	470	100
	Exports	18	500	36	32	900	64	Negligible	Negligible	Negligible	50	1,400	100
	Supply of energy	470	13,000	55	360	10,000	43	22	610	2.6	850	24,000	100
1945	Production	600	17,000	54	480	13,000	43	37	1,000	3.3	1,100	31,000	100
	Imports	0.44	12	2.0	22	600	98	Negligible	Negligible	Negligible	22	620	100
	Exports	30	830	33	60	1,700	67	Negligible	Negligible	Negligible	89	2,500	100
	Supply of energy	580	16,000	54	450	12,000	42	37	1,000	3.5	1,100	29,000	100
1950	Production	540	15,000	44	640	18,000	53	44	1,200	3.6	1,200	34,000	100
	Imports	0.34	9.6	0.58	59	1,600	99	Negligible	Negligible	Negligible	60	1,700	100
	Exports	28	770	34	54	1,500	66	Negligible	Negligible	Negligible	82	2,300	100
	Supply of energy	510	14,000	42	650	18,000	54	44	1,200	3.6	1,200	33,000	100
1955	Production	480	13,000	35	850	24,000	62	50	1,400	3.6	1,400	38,000	100
	Imports	0.44	12	0.46	95	2,700	100	Negligible	Negligible	Negligible	96	2,700	100
	Exports	51	1,400	48	55	1,500	52	Negligible	Negligible	Negligible	110	2,900	100
	Supply of energy	420	12,000	31	890	25,000	65	50	1,400	3.7	1,400	38,000	100
1960	Production	610	17,000	34	1,100	31,000	62	70	1,900	3.9	1,800	50,000	100
	Imports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Exports	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
	Supply of energy	610	17,000	34	1,100	31,000	62	70	1,900	3.9	1,800	50,000	100

a. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. The energy content of hydroelectric power has been equated to the energy content of the average amount of coal consumed in the US in 1955 in producing 1,000 kilowatt-hours (kwh) of electricity at thermal power stations, or 0.43 ton of standard fuel per 1,000 kwh. 11/ It is recognized, however, that the fuel-consumption rate per kwh in the US has shown a continual downward trend during the 1940-55 period. Figures in this column were derived from those given in Table 24, p. 41, below.
c. Figures in this column were taken from Tables 12 and 13, pp. 27 and 28, respectively, below.
d. British thermal units. Each figure in this column was derived from the figure immediately to the left of it on the same line by use of a conversion factor of 27,780,000 Btu per ton of standard fuel.
e. Figures in this column were taken from Tables 18 and 19, pp. 35 and 36, respectively, below.

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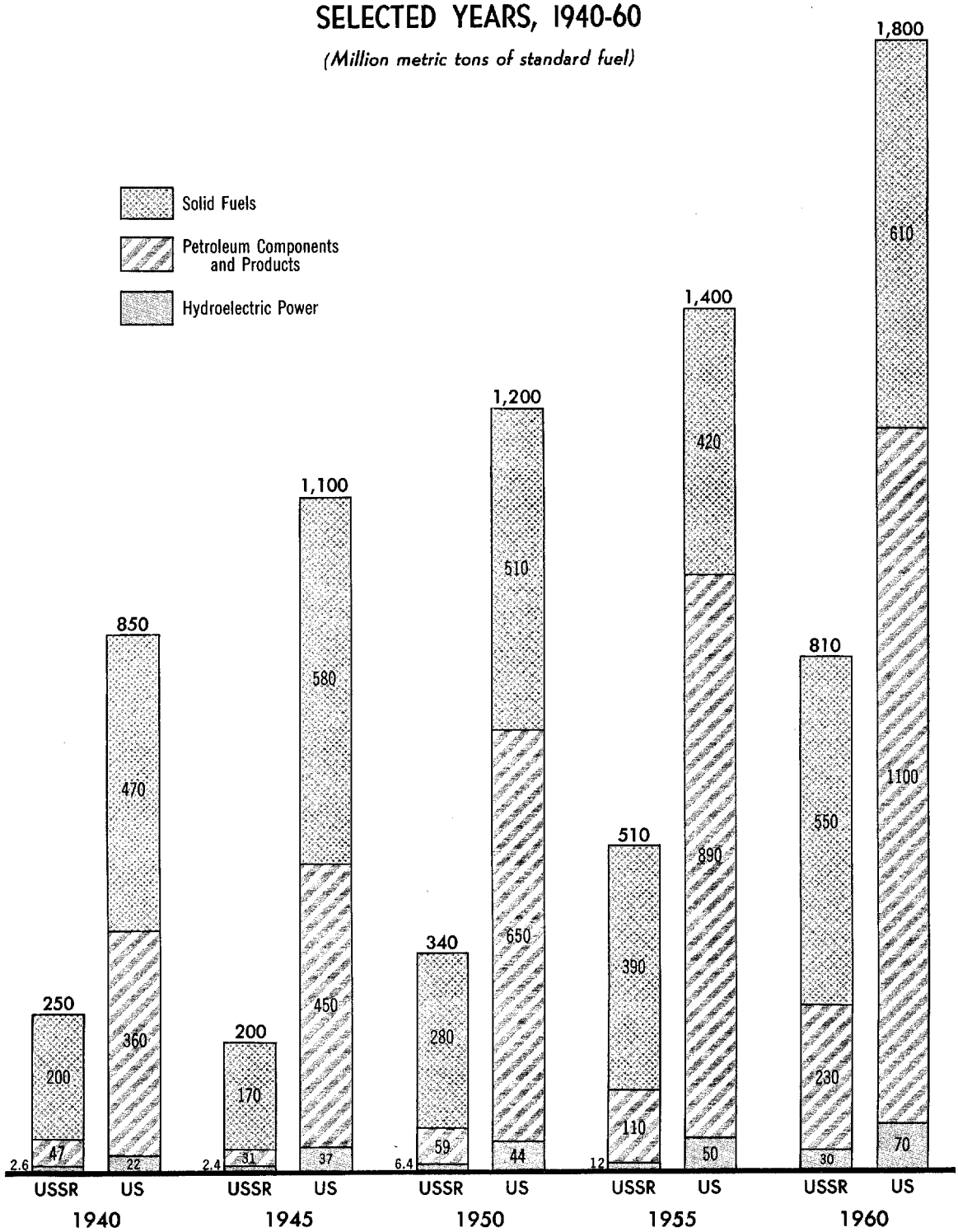
Figure 1

ESTIMATED MAGNITUDE AND STRUCTURE OF THE SUPPLY OF ENERGY IN THE USSR AND IN THE US SELECTED YEARS, 1940-60

(Million metric tons of standard fuel)



All data have been rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.

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13 percent; from 1951 through 1955, it increased by 14 percent; and it is estimated that it will increase by 31 percent during the 5-year period ending in 1960.

The ratio of the supply of energy in the US to that in the USSR, after increasing from 3.4 to 1 in 1940 to 5.3 to 1 in 1945, decreased to 3.5 to 1 in 1950 and to 2.7 to 1 in 1955. It is estimated that by 1960 this ratio will decrease to 2.2 to 1.

B. Soviet Supply Relative to Industrial Production.

Although the supply of energy in the USSR has increased rapidly since 1940, the Soviet economy experienced periodic shortages of energy during the Fifth Five Year Plan period and through mid-1956. 12/ As Soviet industrial production rose 76 percent from 1950 to 1955, 13/ it and the other sectors of the Soviet economy were supported by supply of energy which increased concomitantly by only 50 percent.* The disproportionately high increase in industrial production relative to the increase in the supply of energy could hardly have occurred without causing an occasional strain on the supply of energy.

The USSR plans to eliminate energy shortages and to increase state fuel reserves by 1960. 14/ An integral part of these plans is a provision to have a more proportionate increase of the supply of energy relative to industrial production during the Sixth Five Year Plan (1956-60) period than occurred during the Fifth Five Year Plan period. If Soviet plans to increase the supply of energy by 59 percent* during 1956-60 are fulfilled, the supply will be called on to support only a 65-percent increase in Soviet industrial production. 15/

C. Supply Relative to the Civilian Labor Force.

A better perspective of the supply of energy in the USSR may be gained by comparing the amount of energy available per civilian worker in the USSR with the amount of energy available per civilian worker in the US. Estimates of the supply of energy, the civilian labor force, and the supply of energy per worker in both the USSR and the US during 1950, 1955, and 1960 are shown in Table 3.**

* Based on estimates given in Table 1, p. 9, above.
** Table 3 follows on p. 12.

Table 3

Estimated Supply of Energy, Civilian Labor Force, and Supply of Energy per Worker in the USSR and in the US a/ 1950, 1955, and 1960

	USSR			US			
Year	Supply of Energy b/ (Million Metric Tons of Standard Fuel)	Civilian Labor Force Excluding Forced Labor c/ (Million Persons)	Supply of Energy per Worker (Metric Tons of Standard Fuel)	Supply of Energy d/ (Million Metric Tons of Standard Fuel)	Civilian Labor Force (Million Persons)	Supply of Energy per Worker (Metric Tons of Standard Fuel)	Ratio of the Supply of Energy per Worker in the Civilian Labor Force of the US to that of the USSR
1950	340	90	3.8	1,200	63 e/	19	5.0
1955	510	100	5.1	1,400	66 f/	21	4.1
1960	810	110	7.4	1,800	70 g/	26	3.5

a. All data are rounded to two significant figures.
b. Figures in this column were taken from Table 1, p. 9, above.
c. 16/
d. Figures in this column were taken from Table 2, p. 10, above.
e. 17/
f. 18/
g. This figure was derived by a involved methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for this estimate are available in CIA files.

According to Table 3, the amount of energy available per worker in the civilian labor force of the USSR rose from 3.8 tons of standard fuel in 1950 to 5.1 tons of standard fuel in 1955 and is scheduled to reach 7.4 tons of standard fuel in 1960. The amount of energy available per worker in the civilian labor force of the US is estimated to have been 19 tons of standard fuel in 1950 and 21 tons of standard fuel in 1955 and may reach 26 tons of standard fuel in 1960.

The ratio of the amount of energy available per worker in the civilian labor force of the US to the amount of energy available per civilian worker in the USSR is estimated accordingly at 5.0 to 1 in 1950, 4.1 to 1 in 1955, and 3.5 to 1 in 1960.

D. Change in the Structure of the Supply.

Solid fuels constitute the major source of energy in the USSR.* Although the percentage of the total supply contributed by solid fuels has fallen from 84 in 1945 to 81 in 1950 and to 76 in 1955, solid fuels should still furnish 68 percent of the energy supply of the USSR through 1960. Petroleum components (including natural gas) and products are an increasingly important part of the Soviet supply of energy. The share of the supply of energy contributed by petroleum components and products rose from 15 percent of the total in 1945 to 17 percent in 1950 and 20 percent in 1955 and may reach 28 percent in 1960. Production of hydroelectric power in the USSR, although it has constantly increased since 1940, will amount to only 3.6 percent of the projected supply of energy in the USSR in 1960.

Although solid fuels made the largest contribution to the supply of energy in the US during the years from 1940 to 1945, by 1950 the major share of energy used in the US came from petroleum.** The percentage of the US supply of energy contributed by solid fuels fell from 54 percent in 1945 to 42 percent in 1950 and to 31 percent in 1955 and should be about 34 percent in 1960. The share of the US supply of energy contributed by petroleum components and products was 43 percent in 1940, 42 percent in 1945, 54 percent in 1950, and 65 percent in 1955, and should reach about 62 percent in 1960. In the US, as in the USSR, production of hydroelectric power, although it has constantly increased since 1940, should provide only 3.9 percent of the projected supply of energy in the US in 1960.

* See Table 1, p. 9, above, and Figure 1, following p. 10, above.
** See Table 2, p. 10, above, and Figure 1, following p. 10, above.

III. Regional Distribution of Production of Primary Energy in the USSR in 1955.*

Estimated production of primary energy in the USSR, by economic region, in 1955 is shown in Table 4.** Because estimates are not available, the regional distribution of production of fuelwood, natural gas, and natural gas liquids in the USSR in 1955 is not included in Table 4. Although production of natural gas liquids was undoubtedly insignificant as a source of primary energy on a regional basis, production of both fuelwood and natural gas probably contributed significantly to production of primary energy in certain economic regions in that year. The location of areas producing natural gas in the USSR in 1955 is shown in Figure 3.*** Because estimates are not available of the regional distribution of production of fuelwood in the USSR in 1955, it should be understood that the estimates given in Table 4 and discussed in A, below, exclude production of fuelwood. Because estimates are not available of the regional distribution of production of either natural gas or natural gas liquids, regional production of only one of the petroleum components, crude oil, can be given in Table 4 and discussed in B, below.

A. Solid Fuels.****

In 1955 the major portion of production of primary energy in every economic region of the USSR, with two exceptions, was obtained from solid fuels. Solid fuels contributed 56 percent of production of primary energy in the Urals (Region VIII), 73 percent in Kazakhstan and Central Asia (Region X), 87 percent in the North and Northwest (Region I), 91 percent in the South and Southeast (Regions III and IV) combined, and more than 92 percent in all other regions of the USSR, with the exception of the Transcaucasus (Region V) and the Volga

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* For the regional distribution of production of primary energy in the USSR in 1955, see Figure 2, following p. 16.

** Table 4 follows on p. 16.

*** Following p. 16.

**** For estimates of the regional distribution of production in the USSR in 1955 of each of the solid fuels except fuelwood, see Table 6, p. 21, below.

(Region VI) Regions. Only 7.4 percent of the primary energy produced in the Transcaucasus and only 1.3 percent of that produced in the Volga Region were obtained from solid fuels.

The greatest production of solid fuels occurred in the South and Southeast Regions combined. West Siberia (Region IX) produced the second largest amount of solid fuels produced by any economic region of the USSR in 1955, producing almost twice as much as each of the next three regions in order of importance -- the Urals, the Central (Region VII), and Kazakhstan and Central Asia.

B. Crude Oil.

Crude oil contributed the major proportion of production of primary energy in 1955 in only two economic regions of the USSR, the Transcaucasus and the Volga. In the Transcaucasus, crude oil contributed 84 percent of regional production of primary energy; in the Volga Region, 98 percent. Two other regions where crude oil contributed a significant share of regional production of primary energy were Regions VIII and X. Crude oil accounted for 42 percent of production of primary energy in the Urals and 22 percent in Kazakhstan and Central Asia. According to Table 4,* no crude oil was produced in 1955 in the West (Region II), the Central Region, West Siberia, or East Siberia (Region XI).

In 1955, 35 percent of total production of crude oil in the USSR was produced in the Volga Region. The Urals and the Transcaucasus produced 23 percent and 22 percent, respectively, of the total. The Southeast produced 9.9 percent of the total, and Kazakhstan and Central Asia produced 8 percent of the total. Other regions produced less than 1 percent.

C. Hydroelectric Power.

Hydroelectric power contributed more than 10 percent of total regional production of primary energy in only one region of the USSR in 1955. Hydroelectric power contributed 11 percent of production of primary energy in the North and Northwest Region. An estimated 8.4 percent of regional production of primary energy was produced as hydroelectric power in the Transcaucasus, 6.8 percent in the West, 4.9

* P. 16, below.

Table 4

Estimated Production of Primary Energy
in the USSR, by Economic Region a/
1955

Economic Region	Solid Fuels b/			Crude Oil c/			Hydroelectric Power d/			Total		
	Million Metric Tons of Standard Fuel	Trillion Btu e/	Percent of Regional Total	Million Metric Tons of Standard Fuel	Trillion Btu e/	Percent of Regional Total	Million Metric Tons of Standard Fuel	Trillion Btu e/	Percent of Regional Total	Million Metric Tons of Standard Fuel	Trillion Btu e/	Regional Production as Percent of Total Production
I (North and Northwest)	17	480	87	0.32	8.9	1.6	2.2	60	11	20	540	4.3
II (West)	5.8	160	93	0	0	0	0.42	12	6.8	6.2	170	1.4
III and IV (South and Southeast) f/	140	3,900	91	10	300	7	2.4	68	1.6	150	4,300	34
V (Transcaucasus)	1.9	53	7.4	22	600	84	2.2	60	8.4	26	710	5.7
VI (Volga)	0.50	14	1.3	35	970	98	0.22	6.1	0.62	36	990	7.9
VII (Central)	28	780	95	0	0	0	1.4	40	4.9	29	820	6.5
VIII (Urals)	31	860	56	23	640	42	0.90	25	1.6	55	1,500	12
IX (West Siberia)	58	1,600	100	0	0	0	Negligible	Negligible	Negligible	58	1,600	13
X (Kazakhstan and Central Asia)	27	740	73	8.0	220	22	1.8	49	4.9	37	1,000	8.1
XI (East Siberia)	18	500	100	0	0	0	Negligible	Negligible	Negligible	18	500	4.0
XII (Far East)	12	330	92	1	30	8	Negligible	Negligible	Negligible	13	360	2.9
Total g/										450	13,000	100

a. Estimates of production in 1955 of fuelwood, natural gas, and natural gas liquids in the USSR, by economic region, are not available. Estimates of production of solid fuels given in this table, therefore, do not include production of fuelwood. With two exceptions, all data are rounded to two significant figures. Figures given for production of crude oil in Economic Regions III, IV, and XII can be given only to one significant figure. Totals were derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. Figures in these columns were taken from Table 6, p. 21, below.
c. Figures in these columns were taken from Table 15, p. 32, below.
d. Figures in these columns were taken from Table 23, p. 40, below. The energy content of hydroelectric power has been equated to the energy content of the average amount of coal consumed in the USSR in 1955 in producing 1,000 kilowatt-hours (kwh) of electricity at thermal power stations, or 0.50 ton of standard fuel per 1,000 kwh. 19/
e. British thermal units. Each figure in this column was derived from the figure immediately to the left of it on the same line by use of a conversion factor of 27,780,000 Btu per ton of standard fuel.
f. No estimate is available of the magnitude of coal production in either of these two regions during 1955. The two regions have therefore been combined. The amount of crude oil or hydroelectric power produced in each of these regions, however, is shown in Tables 15 and 23, pp. 32 and 40, respectively, below.
g. For the share contributed by solid fuels, crude oil, and hydroelectric power to total production of primary energy in the USSR in 1955, when production of both fuelwood and natural gas is considered, see Table 1, p. 9, above.

Regional Contribution to the Production of Primary Energy* in the USSR, by Percentages, 1955

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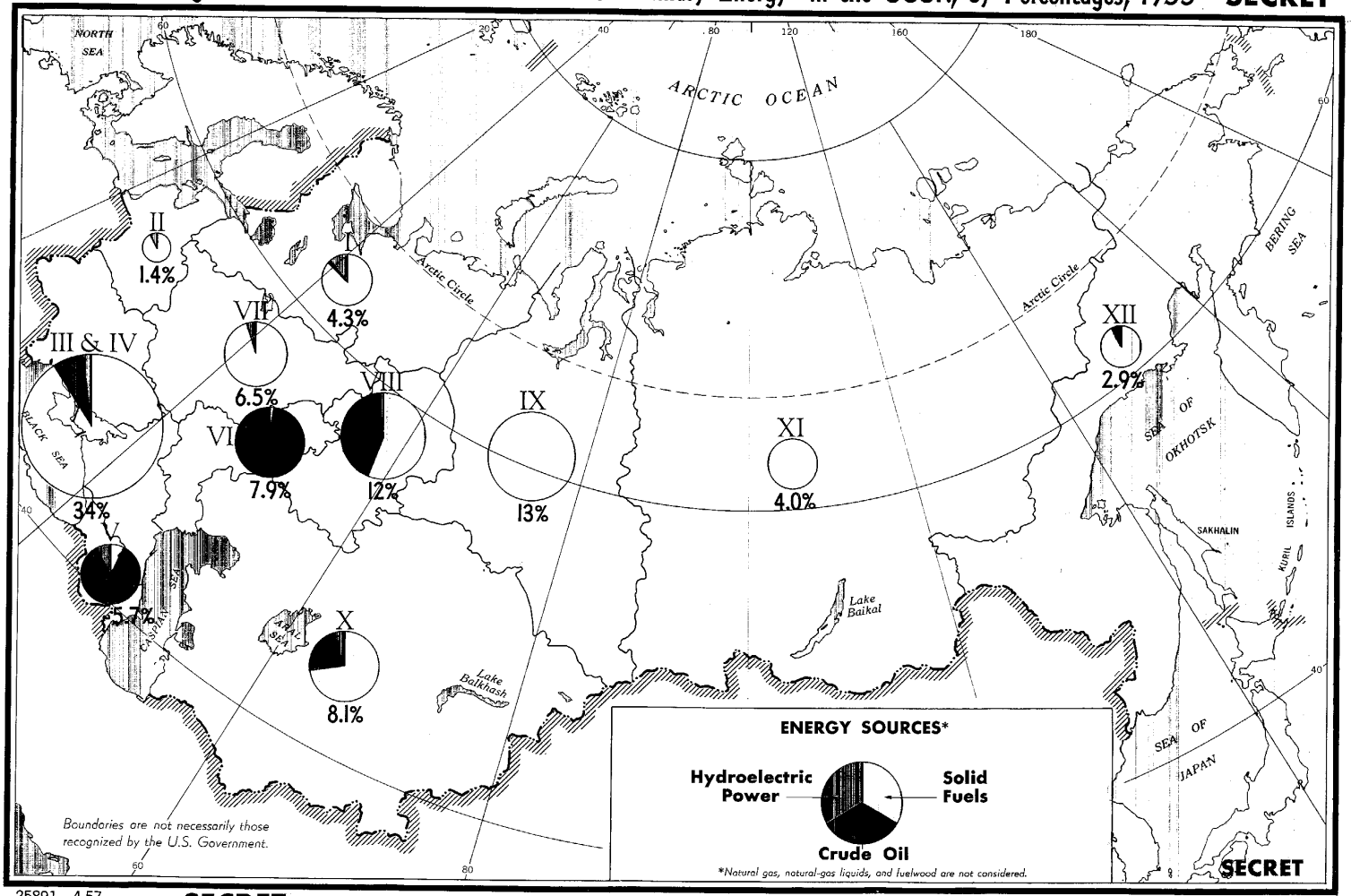

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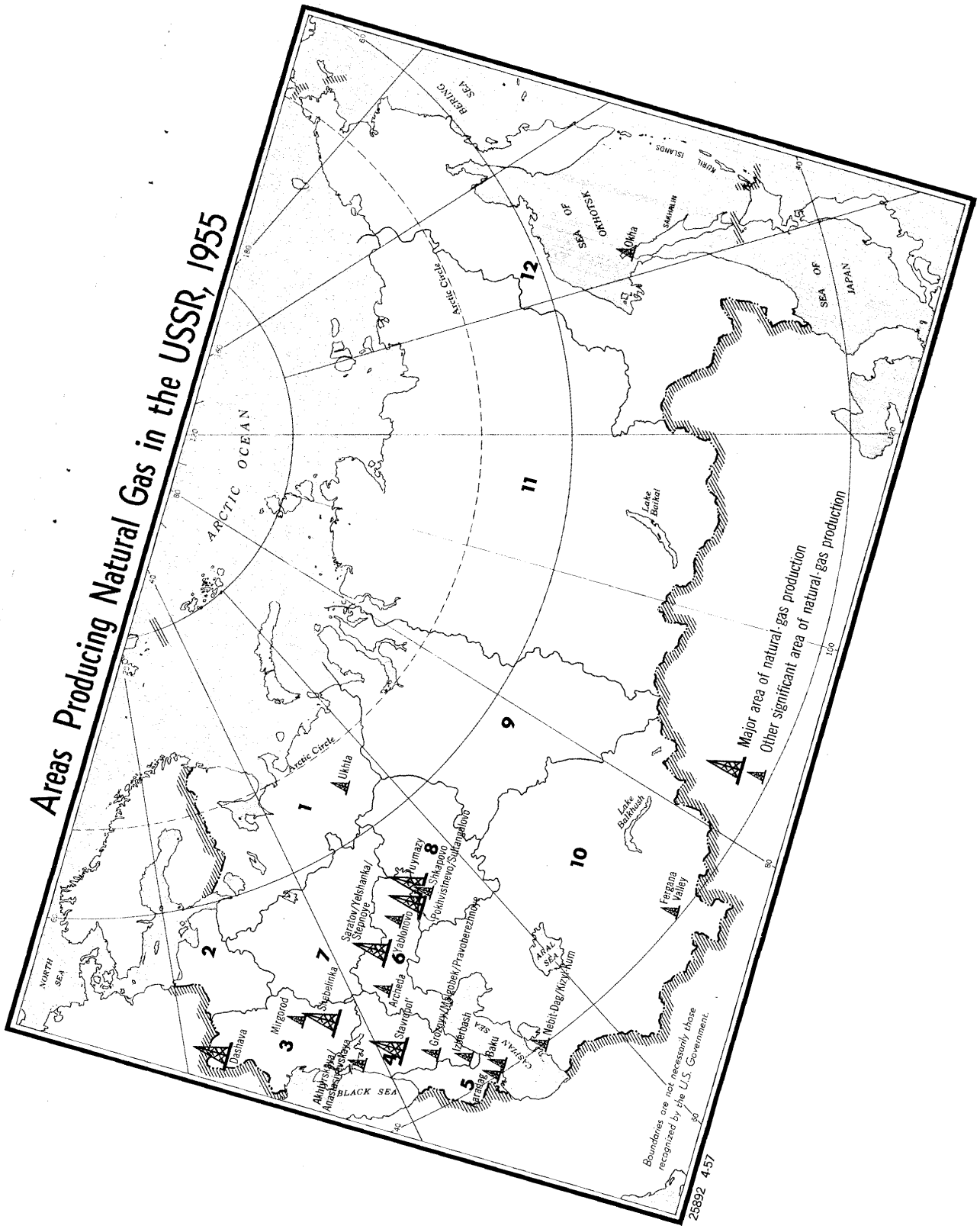

percent in the Central Region, 4.9 percent in Kazakhstan and Central Asia, 1.6 percent in the South and Southeast combined, 1.6 percent in the Urals, and less than 1 percent in all other regions.

In 1955 the North and Northwest and the Transcaucasus were the leasing producers of hydroelectric power, each producing 4.3 billion kwh. The South and the Kazakhstan and Central Asia Regions each produced 3.5 billion kwh. Other regions which produced significant amounts of hydroelectric power in 1955 were the following: the Central, 2.9 billion kwh; the Urals, 1.8 billion kwh; the Southeast, 1.4 billion kwh; and the Volga, 0.44 billion kwh. Negligible quantities of hydroelectric power were produced in the other regions.

APPENDIX A

STATISTICAL DATA ON SOLID FUELS

In this appendix, statistical data on production of and trade in solid fuels both in the USSR and in the US are shown in Tables 5 through 13.

Table 5

Estimated Production of Primary Solid Fuels in the USSR a/
Selected Years, 1940-60

Type of Fuel	Unit	1940	1945	1950	1955	1960
Hard coal	Million metric tons	140 b/	99 b/	190 b/	280 b/	420 c/
Lignite	Million metric tons	26 b/	50 b/	76 b/	110 b/	170 c/
Total	Million metric tons	170 b/	150 b/	260 b/	390 b/	590 d/
Peat e/	Million metric tons	33 f/	22 f/	36 f/	51 f/	73 g/
Oil shale h/	Million metric tons	2.6 i/	1 j/	4.7 k/	11 l/	20 m/
Fuelwood	Million cubic meters	240 n/	200 n/	180 n/	160 o/	140 o/
Total	Million metric tons of standard fuel	200	170	270	380	550

a. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. 20/
c. This figure was computed on the assumption that hard coal will contribute the same percentage of total production in 1960 as it did in 1955.

Table 5

Estimated Production of Primary Solid Fuels in the USSR a/
Selected Years, 1940-60
(Continued)

d. 21/
e. Data pertain only to that part of the peat produced which was used for fuel.
f. 22/
g. Planned production in 1960 is 44 percent larger than reported production in 1955. 23/
h. Data include all the oil shale produced, whether the shale was used directly as fuel or processed into shale oil and gas.
i. Production in the Estonian SSR was 1,886,000 tons in 1940 24/; that in the RSFSR was 731,000 tons. 25/
j. Production in the Estonian SSR was 823,800 tons in 1945 26/; that in the RSFSR has been estimated at 175,000 tons. 27/
k. Production in 1955 was 2.3 times that in 1950. 28/
l. 29/
m. It was assumed both that the Soviet plan to produce 67 percent more oil shale in 1960 than in 1955 30/ will be fulfilled and that a pledge made by Estonian workers to exceed planned production for 1960 by 2.25 million tons 31/ will also be fulfilled.
n. 32/
o. No information is available concerning the magnitude of production of fuelwood in the USSR since 1950. The estimates for 1955 and 1960 are made on the assumption that Soviet production of fuelwood continues to decline from the level reached in 1950.

Table 6

Estimated Production of Primary Solid Fuels in the USSR, by Economic Region a/
1955

Thousand Metric Tons of Standard Fuel

Economic Region	Hard Coal b/	Lignite b/	Total Coal b/	Peat c/	Oil Shale d/	Fuelwood	All Solid Fuels Except Fuelwood
Ia (Northwest)	320	270	600	1,700	810	N.A.	3,100
Ib (North)	13,000	1,000	14,000	90	0	N.A.	14,000
IIa (Baltic)	0	0	0	1,100	2,100	N.A.	3,200
IIb (Belorussia)	0	0	0	2,600	0	N.A.	2,600
III and IV (South and Southeast)	140,000	5,500	140,000	2,000 e/	0	N.A.	140,000
V (Transcaucasus)	1,900	64	1,900	Negligible	0	N.A.	1,900
VI (Volga)	0	11	11	300	200	N.A.	500
VII (Central)	0	18,000	18,000	9,900	0	N.A.	28,000
VIII (Urals)	13,000	17,000	30,000	1,100	0	N.A.	31,000
IX (West Siberia)	58,000	0	58,000	75	0	N.A.	58,000
Xa (Kazkhstan)	19,000	3,200	23,000	56	0	N.A.	23,000
Xb (Central Asia)	820	3,000	3,800	38	0	N.A.	3,800
XI (East Siberia)	14,000	3,700	18,000	Negligible	0	N.A.	18,000
XII (Far East)	5,500	6,900	12,000	130	0	N.A.	12,000
Total	260,000	59,000	320,000	19,000	3,200	30,000 f/	370,000 g/

a. With two exceptions, all data are rounded to two significant figures. The estimate of production of oil shale in the Volga Region and the estimate of production of all solid fuels except fuelwood in the Volga Region each contain only one significant figure. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. Figures in this column were taken from Table 7, p. 22, below.
c. Figures in this column were taken from Table 8, p. 23, below.
d. Figures in this column were taken from Table 9, p. 24, below.
e. Almost all of the production of peat in these two regions comes from Region III.
f. This figure was derived by multiplying the volume of fuelwood production as shown in Table 5, p. 19, above, by a conversion factor of 1.3 million kilocalories per cubic meter.
g. This figure includes 30 million tons of standard fuel in the form of fuelwood which has not been distributed regionally.

Table 7

Estimated Production of Coal in the USSR,
by Economic Region a/
1955

Economic Region	Hard Coal			Lignite			Total		
	Production (Thousand Metric Tons)	Average Calorific Value b/ (Kilocalories Per Kilogram)	Standard Fuel (Thousand Metric Tons)	Production (Thousand Metric Tons)	Average Calorific Value b/ (Kilocalories Per Kilogram)	Standard Fuel (Thousand Metric Tons)	Production (Thousand Metric Tons)	Average Calorific Value b/ (Kilocalories Per Kilogram)	Standard Fuel (Thousand Metric Tons)
Western regions									
Ia (Northwest)	350	6,400	320	600	3,200	270	950	4,400	600
Ib (North)	14,000	6,300	13,000	2,200	3,200	1,000	17,000	5,900	14,000
II (West)	0	0	0	0	0	0	0	0	0
III and IV (South and Southeast)	140,000 c/	7,000	140,000	14,000	2,800	5,500	150,000	6,600	140,000
V (Transcaucasus)	2,600	5,000	1,900	150	3,000	64	2,700 d/	4,900	1,900
VII (Central)	0	0	0	38,000	3,300	18,000	38,000	3,300	18,000
Subtotal	160,000	6,900	150,000	55,000	3,200	25,000	210,000 e/	5,900	180,000
Eastern regions									
VI (Volga)	0	0	0	25	3,000	11	25	3,000	11
VIII (Urals)	16,000	5,700	13,000	31,000	3,900	17,000	46,000 e/	4,500	30,000
IX (West Siberia)	58,000	7,000	58,000	0	0	0	58,000	7,000	58,000
Xa (Kazakhstan)	23,000	5,900	19,000	5,000	4,400	3,200	28,000 d/	5,600	23,000
Xb (Central Asia)	1,100	5,400	820	4,900	4,300	3,000	5,900 d/	4,500	3,800
XI (East Siberia)	18,000	5,700	14,000	7,100	3,900	3,700	25,000	5,100	18,000
XII (Far East)	6,200	6,100	5,500	12,000	4,000	6,900	18,000	4,700	12,000
Subtotal	120,000	6,400	110,000	60,000	4,000	34,000	180,000 e/	4,800	140,000
Total USSR	280,000 d/	6,700	260,000	110,000 d/	3,600	59,000	390,000 d/	5,800	320,000

a. Some of the figures in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for all estimates not specifically documented in footnotes are available in CIA files. All data are rounded to two significant figures. Totals and averages are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. A description of the methodology by which average calorific values were derived is given in Appendix D.
c. Production in the Donets Basin was 135 million tons. 33/
d. 34/
e. The western regions contributed 53.7 percent of total production of coal in the USSR in 1955; the eastern regions, 46.3 percent (including the 11.9 percent of total production contributed by the Urals). 35/

Table 8

Estimated Production of Peat in the USSR,
by Economic Region a/
1955

Thousand Metric Tons

Economic Region		Production	Standard Fuel b/
Ia	(Northwest)	4,600	1,700
Ib	(North)	250	90
IIa	(Baltic)	2,900	1,100
IIb	(Belorussia)	7,000 c/	2,600
III	(South)	5,200	2,000
IV	(Southeast)	Negligible	Negligible
V	(Transcaucasus)	Negligible	Negligible
VI	(Volga)	800	300
VII	(Central)	26,000	9,900
VIII	(Urals)	3,000	1,100
IX	(West Siberia)	200	75
Xa	(Kazakhstan)	150	56
Xb	(Central Asia)	100	38
XI	(East Siberia)	Negligible	Negligible
XII	(Far East)	350	130
	Total	51,000 d/	19,000

a. Some of the figures in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for all estimates not specifically documented in footnotes are available in CIA files. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with rounded data shown. Data pertain only to that part of the peat produced which was used for fuel.

b. These figures were derived by multiplying the weight of the peat produced in the region by a calorific value of 2,600 kilocalories per kilogram, a value calculated from data supplied in source 36/.

c. 37/

d. 38/

Table 9

Estimated Production of Oil Shale in the USSR,
by Economic Region a/
1955

Thousand Metric Tons

Economic Region	Production	Standard Fuel b/
Ia (Northwest)	2,800	810
IIa (Baltic)	7,200	2,100
VI (Volga)	800 c/	200
Total	11,000 d/	3,200

a. Production of oil shale in any economic region other than those listed in this table has not been reported. Some of the figures in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and the sources for all estimates not specifically documented in footnotes are available in CIA files. With the exception of figures given for the Volga region, all data are rounded to two significant figures. Figures for the Volga Region contain only one significant figure. Because of rounding, totals do not agree with rounded data shown. Data include all the oil shale produced, whether the shale was used directly as fuel or processed into shale oil or shale gas.
b. These figures were calculated by multiplying the weight of the oil shale produced in the region by a calorific value of 2,100 kilocalories per kilogram, a value calculated from data supplied in source 39/.
c. This figure was derived by rounding the difference between the sum of unrounded figures for production in Regions Ia and IIa and the figure which, when rounded, furnished the estimate of total production in the USSR.
d. 40/

S-E-C-R-E-T

Table 10

Estimated Soviet Imports of Primary and Secondary Solid Fuels a/
1945, 1950, and 1955

	Hard Coal			Coke			Fuel Briquettes			Total		
Year	Imports (Thousand Metric Tons)	Average Calorific Value (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)	Imports (Thousand Metric Tons)	Average Calorific Value (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)	Imports (Thousand Metric Tons)	Average Calorific Value (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)	Imports (Thousand Metric Tons)	Average Calorific Value (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)
1945	5,200 b/	6,000 c/	4,500	55 d/	6,000 d/	47	N.A.	N.A.	N.A.	5,300	6,000	4,500
1950	8,900 e/	6,000 f/	7,600	250	6,000 d/	220	2,100 g/	4,700 h/	1,400	11,000	5,800	9,300
1955	8,700 i/	6,000 f/	7,500	430	6,000 d/	370	2,500 g/	4,700 h/	1,700	12,000	5,700	9,600

a. Available information indicates that during 1945, 1950, and 1955 the USSR imported only those types of primary and secondary solid fuels for which figures are given. Some of the figures in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for all estimates not specifically documented in footnotes are available in CIA files. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.

b. 41/

c. The only known imports of coal into the USSR in 1945 were those from Poland. The calorific value of the Polish coal imported by the USSR in 1945 was derived from source 42/.

d. The only known imports of coke into the USSR during 1945, 1950, and 1955 were those from Poland. The calorific value of Polish coke during each of these years has been set at the same calorific value reported for Polish coal. 43/

e. Imports of Chinese coal in 1950 probably approached 500,000 tons. 44/ Imports of Polish coal during the same year amounted to 8.4 million tons. 45/

f. The average calorific value of Chinese coal has been reported as 6,500 kilocalories per kilogram (kc/kg). 46/ The average calorific value of Polish coal has been reported as 6,000 kc/kg. 47/ These values were taken as the average calorific values of Polish and Chinese coals in computing the weighted average calorific value given in this table for Soviet imports of coal in 1950 and 1955.

g. The only known imports of fuel briquettes into the USSR in either 1950 or 1955 were those from East Germany. The figure for imports of fuel briquettes in 1950 was taken from source 48/

h. 49/

i. In 1955 the USSR imported 540,000 tons of hard coal from China 50/ and 8.2 million tons of hard coal from Poland. 51/

Table 11

Estimated Soviet Exports of Primary and Secondary Solid Fuels a/
1950 and 1955

Year	Hard Coal			Coke			Total		
	Exports b/ (Thousand Metric Tons)	Average Calorific Value c/ (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)	Exports d/ (Thousand Metric Tons)	Average Calorific Value e/ (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)	Exports (Thousand Metric Tons)	Average Calorific Value (Kilocalories per Kilogram)	Standard Fuel (Thousand Metric Tons)
1950	230	6,700	220	220	6,500	210	460	6,600	430
1955	2,000	6,700	1,900	570	6,500	530	2,600	6,600	2,400

a. Available information indicates that during 1950 and 1955 the USSR exported only those types of primary and secondary solid fuels for which figures are given. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with rounded data shown.
b. This estimate was derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for this estimate are available in CIA files.
c. See Table 7, p. 22, above.
d. 52/
e. 53/

S-E-C-R-E-T

Table 12

Estimated Production of Solid Fuels in the US a/
Selected Years, 1940-60

			1940		1945		1950		1955		1960	
Type of Fuel	Unit of Measure	Calorific Value of Fuel	Production	Standard Fuel	Production	Standard Fuel	Production	Standard Fuel	Production	Standard Fuel	Production	Standard Fuel
Anthracite	Million metric tons	7,080 kc/kg b/	47 c/	47	50 c/	50	40 d/	40	24 e/	24	24 f/	24
Bituminous coal	Million metric tons	7,280 kc/kg b/	420 c/	430	520 c/	540	470 d/	480	420 e/	440	550 f/	580
Lignite	Million metric tons	3,890 kc/kg b/	2.7 c/	1.5	2.4 c/	1.3	3.1 d/	1.7	2.7 e/	1.5	3.0 f/	1.7
Total coal	Million metric tons		460	480	570	590	510	530	450	470	580	600
Fuelwood	Million cubic meters	1,300,000 kilocalories per cubic meter g/	30 h/	5.6	56 i/	10	52 i/	9.7	50 j/	9.3	50 j/	9.3
Total				490		600		540		480		610

a. Significant production in the US of types of solid fuels other than those for which figures are given is neither recorded nor anticipated. All data are rounded to two significant figures. Totals and figures for standard fuel are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. Kilocalories per kilogram. 54/
c. 55/
d. 56/
e. 57/
f. 58/
g. 59/
h. The estimate for 1940 is the same figure as that estimated for 1938 in source 60/.
i. 61/
j. Estimate. Production in 1954 amounted to 48 million cubic meters. 62/

Table 13

Estimated US Foreign Trade in Primary and Secondary Solid Fuels a/
Selected Years, 1940-55

Million Metric Tons

Trade	1940 Shipments	1940 Standard Fuel	1945 Shipments	1945 Standard Fuel	1950 Shipments	1950 Standard Fuel	1955 Shipments	1955 Standard Fuel
Imports								
Anthracite	0.12 b/	0.12	Negligible c/	Negligible	0.016 d/	0.016	Negligible e/	Negligible
Bituminous coal	0.34 f/	0.35	0.42 g/	0.44	0.32 h/	0.33	0.42 i/	0.44
Total	0.46	0.47	0.42	0.44	0.33	0.34	0.42	0.44
Exports								
Anthracite	2.4 b/	2.4	3.3 c/	3.4	3.5 d/	3.6	2.9 e/	2.9
Bituminous coal	15	16	25 j/	26	23 k/	24	46 e/	48
Total	17	18	29	30	27	28	49	51

a. No significant quantity of any type of primary or secondary solid fuel other than anthracite or bituminous coal was involved in the foreign trade of the US during 1940-55. Data in the sources used were expressed in short tons and have been converted to metric tons. Calorific values of anthracite and bituminous coal are assumed to be equivalent to the average calorific value of the same coals produced in the US, as given in source 63/. All data are rounded to two significant figures. Totals are derived independently from unrounded data and do not always agree with the sum of the rounded components.
b. 64/
c. 65/
d. 66/
e. 67/
f. 68/
g. 69/
h. 70/
i. 71/
j. 72/
k. 73/

APPENDIX B

STATISTICAL DATA ON PETROLEUM COMPONENTS AND PRODUCTS

In this appendix, statistical data on the production of and trade in petroleum components and products both in the USSR and in the US are shown in Tables 14 through 19.

Table 14

Estimated Production of Petroleum Components in the USSR a/
Selected Years, 1940-60

Million Metric Tons

	Crude Oil		Natural Gas		Total	
Year	Production	Standard Fuel	Production	Standard Fuel	Production	Standard Fuel
1940	31.1 b/	43.9	2.20 c/	3.34	33.3	47.2
1945	19.4 b/	27.4	2.20 d/	3.34	21.6	30.7
1950	37.9 b/	53.4	3.71 e/	5.64	41.6	59.0
1955	70.8 b/	99.8	5.49 e/	8.34	76.3	108
1960	135 f/	190	26.0 e/	40.0	161	230

a. Estimates for production of natural gas liquids in the USSR during the selected years are not available. The estimates of production of crude oil, however, may include part or all of the Soviet production of natural gas liquids if available information is correct. 74/ All data are rounded to three significant figures with the exception of data pertaining to natural gas in 1960 which contain only two significant figures.

b. 75/

c. Production of natural gas in the USSR in 1930 has been reported as 472,600 tons of "equivalent oil." 76/ Because it was common Soviet practice to consider 1,000 cubic meters of natural gas as equivalent to 1 ton of crude oil, it has been inferred that production of natural gas in the USSR in 1930 was 472.6 million cubic meters. Because production of natural gas in the USSR in 1940 was 5.9 times that in 1930, 77/ production of natural gas in 1940 must have amounted to 2.79 billion cubic meters. A conversion factor of 790 tons per million cubic meters was applied to the figure of 2.79 billion to derive the estimate given.

d. Production of natural gas in the USSR in 1946 was 6.73 times that in 1930 and 1.14 times that in 1945. 78/ A conversion factor of 790 tons per million cubic meters was used in converting volume to weight.

e. 79/

f. 80/

Table 15

Estimated Production of Crude Oil in the USSR, by Economic Region a/ 1955

Thousand Metric Tons

Economic Region	Production	Standard Fuel
Western regions		
I (North and Northwest)	230 b/	320
II (West)	0 c/	0
III (South)	531 c/	749
IV (Southeast)	7,000 d/	10,000
V (Transcaucasus)	15,348 c/	21,600
Subtotal	23,000 e/	32,000
Eastern regions		
VI (Volga)	25,000 f/	35,000
VII (Central)	0 g/	0
VIII (Urals)	16,000 f/	23,000
IX (West Siberia)	0 g/	0
X (Kazakhstan and Central Asia)	5,652 c/	7,970
XI (East Siberia)	0 g/	0
XII (Far East)	1,000 h/	1,000
Subtotal	47,000 e/	66,000
Total RSFSR	49,262 c/	69,500
Grand total USSR	70,793 c/	99,800

a. Zeros which have no figures other than a zero to the right of them are not significant. All other figures are significant. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.

b. 81/

c. 82/

d. This figure was derived by rounding the result obtained by subtracting production indicated for the other western regions from the figure derived for total production of the western regions.

e. Yevseyenko, Minister of the Petroleum Industry, stated that nearly two-thirds of the crude oil produced in the USSR in 1955 was produced in the eastern regions. 83/ It is inferred that in 1955 the eastern regions produced 67 percent and the western regions 33 percent of 70.8 million tons.

f. Yevseyenko stated that in December 1955 Regions VI and VIII accounted for 58 percent of all crude oil produced in the USSR. 84/ On the basis of a detailed analysis of the regional distribution of Soviet production of crude oil, a reliable source indicates that 60 percent of production in these regions in 1955 came from Region VI and 40 percent from Region VIII. 85/ These percentages, applied to an estimate of 40.6 million tons, yielded the estimates for Regions VI and VIII, respectively.

g. A Soviet textbook on the geography of the USSR published in Moscow in 1955 indicates that crude oil was being produced in 1955 in all economic regions except II, VII, IX, and XI. 86/

h. Derived by rounding the result obtained by subtracting total production indicated for other regions in the RSFSR from the estimate for total production in the RSFSR.

Table 16

Estimated Production of Both Natural Gas and Certain Manufactured Gas in the USSR a/
Selected Years, 1940-60

Billion Cubic Meters

Year	Natural Gas	Certain Manufactured Gas b/	Total
1940	2.8 c/	0.60	3.4 d/
1945	2.8 e/	Negligible f/	2.8
1950	4.7 g/	1.5 h/	6.2 d/
1955	7.0 i/	3.4 i/	10 d/
1960	33 i/	6.7 i/	40 i/

a. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. Includes the entire production of shale gas, the entire production of gas from the underground gasification of coal, and an indeterminate, small percentage of gas from the above-ground gasification of coal.
c. Production of natural gas in the USSR in 1930 has been reported as 472,600 tons of "equivalent oil." 87/ Because it was common Soviet practice to consider 1,000 cubic meters of natural gas as equivalent to 1 ton of crude oil, it has been inferred that production of natural gas in the USSR in 1930 amounted to 472.6 million cubic meters. Production of natural gas in the USSR in 1940 was 5.9 times that in 1930. 88/
d. 89/
e. Production of natural gas in the USSR in 1946 was 6.73 times that in 1930 90/ and 1.14 times that in 1945. 91/
f. The operation of shale gas plants or of installations for the underground gasification of coal in the USSR in 1945 has not been reported.
g. Production of natural gas in the USSR in 1946 was 1.14 times that in 1945; in 1947, 1.22 times that in 1946; in 1948, 1.10 times that in 1947; in 1949, 1.03 times that in 1948; and in 1950, 1.07 times that in 1949. 92/
h. This figure represents the difference between the indicated total production of gas and the indicated production of natural gas.
i. 93/ The USSR announced 94/ in September 1956 that the goal of 40 billion cubic meters for production of gas in the USSR in 1960 had been raised to 46 billion cubic meters. No information has been made available, however, concerning what portion of the 6-billion-cubic-meter increment is to be composed of natural gas or what portion is to be composed of manufactured gas.

Table 17

Estimated Soviet Foreign Trade in Crude Oil and Petroleum Products a/
1955

Thousand Metric Tons

	Crude Oil		Petroleum Products		Total	
Trade	Shipments	Standard Fuel	Shipments	Standard Fuel	Shipments	Standard Fuel
Exports	1,300	1,900	3,200	4,800	4,500	6,700
Imports	35	49	4,400	6,600	4,400	6,600

a. No reports are available to indicate that natural gas has ever entered into the foreign trade of the USSR. The data on petroleum products probably include indeterminate quantities of natural gas liquids. Estimates of the weight of crude oil and petroleum products were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for these estimates are available in CIA files. All data are rounded to two significant figures.

Table 18

Estimated Production of Petroleum Components in the US a/
Selected Years, 1940-60

Million Metric Tons

	Crude Oil		Natural Gas Liquids		Natural Gas		Total	
Year	Production b/	Standard Fuel	Production c/	Standard Fuel d/	Production e/	Standard Fuel f/	Production	Standard Fuel
1940	190	270	8.1	14	59	96	260	380
1945	230	320	11	19	88	140	330	480
1950	270	380	18	31	140	230	430	640
1955	330	470	26	44	210	340	570	850
1960	410	580	35	59	290	470	740	1,100

a. All data are rounded to two significant figures. Estimates for 1960 were derived by extrapolation of the data which furnished the estimates given for other years.
b. Data on production were given in units of barrels in source 95/. Barrels have been converted to tons by conversion factors of 7.3 barrels per ton for 1940, 1945, and 1950, and 7.4 barrels per ton for 1955 and 1960. 96/
c. Data on production were given in units of barrels in source 97/. Barrels have been converted to tons by a conversion factor of 0.099987 ton per barrel. 98/
d. Data were derived by multiplying the figures for production by a conversion factor of 47 million British thermal units (Btu) per ton 99/ and by a second factor of 0.035997 million tons of standard fuel per trillion Btu. 100/
e. Data on production were given in units of cubic feet in source 101/. Cubic feet have been converted to tons by a conversion factor of 22.34 tons per million cubic feet. 102/
f. Data were derived by multiplying the figures for production by a conversion factor of 44,685,000 Btu per ton 103/ and by a second factor of 0.035997 million tons of standard fuel per trillion Btu. 104/

Table 19

Estimated US Foreign Trade in Petroleum Components and Products a/
Selected Years, 1940-55

Million Metric Tons

Trade	1940		1945		1950		1955	
	Shipments	Standard Fuel	Shipments	Standard Fuel	Shipments	Standard Fuel	Shipments	Standard Fuel
Imports								
Crude oil	5.8	8.2	10	14	24	34	40	56
Natural gas liquids	b/		b/		b/		b/	
Natural gas	0	0	0	0	0	0	0	0
Petroleum products	5.4	8.1	5.1	7.6	17	26	26	39
Total	11	16.3	15	22	41	59	66	95
Exports								
Crude oil	7.0	9.9	4.5	6.3	4.7	6.6	1.6	2.3
Natural gas liquids	0.18 c/	0.30	0.46	0.78	0.26	0.44	0.40	0.68
Natural gas	4.4	7.1	14	23	20	32	21	34
Petroleum products	10	15	20	30	10	15	12	18
Total	22	32	39	60	35	54	35	55

a. Estimates in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. Data for 1940, 1945, and 1950 are based on information in sources 105/, 106/, and 107/. Data for 1955 are based on information in source 108/. All conversion factors required in deriving the estimates in this table are from source 109/. More explicit methodology and the sources for these estimates are available in CIA files. All data are rounded to two significant figures. Totals are derived independently from unrounded figures and do not always agree with the sum of the rounded components.
b. Imports of natural gas liquids are included among the estimates shown for imports of petroleum products.
c. Natural gasoline only.

APPENDIX C

STATISTICAL DATA ON HYDROELECTRIC POWER

In this appendix, statistical data on production of and capacity to produce power both in the USSR and in the US are shown in Tables 20 through 24.

Hydroelectric power has never been included in Soviet foreign trade, nor is there any indication that it will be included in Soviet foreign trade during 1956-60. Only insignificant amounts of hydroelectric power have been included in US foreign trade in the past, and there is no indication that any increase in this trade will occur during 1956-60. For the purposes of this report, therefore, the amount of hydroelectric power included in the foreign trade of both the USSR and the US has been considered to be nil during the 1940-60 period.

Table 20

Estimated Production of Hydroelectric Power
in the USSR a/
Selected Years, 1940-60

Billion Kilowatt-Hours

Year	Production
1940	5.1 b/
1945	4.8 b/
1950	12.7 b/
1955	23.1 b/
1960	59.0 c/

a. All digits in this table are significant.
b. 110/
c. 111/

Table 21

Estimated Capacity to Produce and Production of Hydroelectric Power in the USSR, by Category of Power Station a/
1955

Category of Power Station	Installed Capacity		Production	
	Million Kilowatts	Percent of Total	Billion Kilowatt-Hours	Percent of Total
Stations with capacities of 10,000 kilowatts or more	5.6 b/	88	21 c/	91
Stations with capacities smaller than 10,000 kilowatts				
Rural	0.42 d/	6.6	N.A.	N.A.
Other	0.4 e/	6	N.A.	N.A.
Subtotal	0.8	12	2 c/	9
Total	6.4 f/	100	23 g/	100

a. All digits in this table are significant.
b. See Table 22, p. 39, below.
c. In recent years almost all hydroelectric power stations in the USSR with a capacity of 10,000 kilowatts (kw) or more have been under the jurisdiction of the Ministry of Electric Power Stations. The production and end-year capacity of the hydroelectric power stations under the jurisdiction of the Ministry of Electric Power Stations in 1954 were reported as 16.842 billion kwh and 4.44 million kw, respectively. 112/ In 1954, annual hours of operation based on end-year capacity is estimated to have been 3,800 hours for stations with a capacity of 10,000 kw or more. The same source also indicated that in 1954 the annual hours of operation of those stations with a capacity of less than 10,000 kw was 2,300 hours. 113/ It was assumed that the number of hours of operation for each of the two categories of hydroelectric power stations was the same in 1955 as it was in 1954.
d. The capacity of rural hydroelectric power stations at the end of 1940 was 34,000 kw. 114/ At the end of 1955 the capacity of these stations was 12 times what it was at the end of 1940. 115/
e. This figure is the difference between the total installed capacity of hydroelectric power stations in the USSR and the sum of the installed capacity of all stations with capacities of 10,000 kw or more and that of rural stations with capacities of less than 10,000 kw.
f. On the basis that the hydroelectric power capacity of the USSR at the end of 1954 was 16 percent of the total electric power capacity of 32.5 million kw, 116/ the hydroelectric power capacity of the USSR as of 1 January 1955 was calculated to be 5.2 million kw. It is estimated that the capacity installed in 1955 at major hydroelectric power stations amounted to 1.1 million kw and at rural and other hydroelectric power stations, to 120,000 kw. These estimates were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources are available in CIA files.
g. 117/

Table 22

Estimated Hydroelectric Power Capacity Installed in Major Hydroelectric Power Stations in the USSR, by Economic Region a/
1955

Thousand Kilowatts

Economic Region		Capacity
I	(North and Northwest) b/	1,000
II	(West)	200
III	(South)	850
IV	(Southeast)	340
V	(Transcaucasus)	1,000
VI	(Volga)	100
VII	(Central)	720
VIII	(Urals)	450
IX	(West Siberia)	0
X	(Kazakhstan and Central Asia)	850
XI	(East Siberia)	0
XII	(Far East)	0
	Total	5,600

a. Only hydroelectric power stations with capacities of 10,000 kilowatts or more are considered to be major stations. Estimates in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for all estimates are available in CIA files. All data are rounded to two significant figures. The total is derived independently from unrounded figures and does not agree with the sum of the rounded components.
b. The entire capacity of Region I is located in the Northwest.

Table 23

Estimated Production of Hydroelectric Power in the USSR, by Economic Region a/
1955

Billion Kilowatt-Hours

Economic Region	Stations with Capacities of 10,000 Kilowatts or More b/	All Stations c/
I (North and Northwest)	4.0 d/	4.3
II (West)	0.78	0.84
III (South)	3.2	3.5
IV (Southeast)	1.3	1.4
V (Transcaucasus)	4.0	4.3
VI (Volga)	0.40	0.44
VII (Central)	2.7	2.9
VIII (Urals)	1.7	1.8
IX (West Siberia)	0	Negligible
X (Kazakhstan and Central Asia)	3.2	3.5
XI (East Siberia)	0	Negligible
XII (Far East)	0	Negligible
Total	21	23

a. All data are rounded to two significant figures.
b. Each figure in this column was derived by assuming that the hydroelectric power capacity in each economic region arising from the operation of stations with capacities of 10,000 kilowatts (kw) or more (as given in Table 22, p. 39, above) was operated for 3,800 hours in 1955 (see Table 21, footnote d, p. 38, above).
c. Each figure in this column was derived by adding to the figure on its left an estimate of production of hydroelectric power in the region arising from the operation of stations with capacities of less than 10,000 kw. The estimate of production from the operation of stations with capacities of less than 10,000 kw in each region was derived in two steps. First, the geographic distribution of total hydroelectric power capacity arising from stations with capacities of 10,000 kw or less, 0.8 million kw, was assumed to be identical to the geographic distribution (see Table 22, p. 39, above) of the hydroelectric power capacity arising from stations with capacities of 10,000 kw or more. A figure was thus derived for the total hydroelectric power capacity in each region arising from plants with capacities of less than 10,000 kw. Second, it was assumed that these relatively small-capacity stations were operated for 2,300 hours in 1955 (see Table 21, footnote d, p. 38, above).
d. The entire production in Region I is located in the Northwest.

Table 24

Estimated Production of Hydroelectric Power in the US a/
Selected Years, 1940-60

Million Kilowatt-Hours

Year	Production
1940	51
1945	85
1950	100
1955	120
1960	160

a. Estimates in this table were derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for these estimates are available in CIA files. All data are rounded to two significant figures.

APPENDIX D

METHODOLOGY

Some of the estimates presented in this report were derived by a complex methodology, based on numerous sources, which it would be impractical to reproduce here. Where these estimates are presented, it has been noted that the methodology and sources are available in CIA files. In this appendix two things are done. First, the methodology used to derive the calorific values given in Table 7, p. 22, above, is described. Second, the rationale is given for the use in this report of a calorific value of 1.41 tons of standard fuel per ton of crude oil for both Soviet and US crude oil.

1. Methodology Used to Derive Calorific Values of Coals.

Regional calorific values given in Table 7, p. 22, above, are weighted combinations of the average calorific values of hard coal and/or lignite produced in each mining area within the region. The weighted average values of the coals mined within the several regions were obtained by estimation or calculation from data in a variety of sources. 118/

For example, the calorific values of hard coal and lignite in the Urals given in Table 7, p. 22, above, were derived as follows:

> In the Urals, 6 mining areas produce hard coal, and 2 areas produce lignite. Calorific values of the hard coal range from a minimum of 4,400 calories 119/ to a maximum of 6,130 calories, 120/ with a calculated weighted average of 5,700 calories, based on total tonnage. The lignite values range from 3,650 kc/kg 121/ to 4,130 kc/kg, 122/ with a calculated weighted average of 3,890 kc/kg. The weighted value of these two averages, 4,490 kc/kg, based on the total tonnage produced in the Urals of each type of coal, has been used in Table 7 as the calorific value of total production of coal in the Urals.

2. Rationale for Using a Calorific Value of 1.41 Tons of Standard Fuel Per Ton for Both Soviet and US Crude Oil.

The average calorific value of the crude oil produced in the US in 1956 can be calculated at approximately 42.6 million Btu or 1.53 tons of standard fuel per ton by using data on production of crude oil in the US in 1956, by states, from source 123/ and data in source 124/ on the calorific values of various typical crude oils in various states. Each ton of crude oil produced in the USSR, however, has been equated to 1.41 tons of standard fuel by Soviet economists in calculating the share of petroleum components in the total Soviet fuel supply. 125/ This figure of 1.41 at first glance seems incredibly low, not only when compared with the figure of 1.53 for US crude oil, but especially when it is considered that any crude oil in the world, free from water, ash, and sulfur, has a minimum calorific value of approximately 1.47 tons of standard fuel per ton. 126/ It can be reasonably assumed, however, that the Soviet economists in discussing fuel balances assign a calorific value to their crude oil which reflects not the calorific value of that oil at the point of production but the amount of heat in that crude oil which will eventually be consumed in fuel form. The techniques and technology of the refining of crude oil in the USSR are sufficiently similar to those in the US to enable the Soviet refineries to produce almost the same amount of fuel from each ton of crude oil as US refineries do. In 1955, only approximately 90 percent by weight of the crude oil charged to US refineries was refined into fuel products.* Because the fuel products derived from crude oil have, in general, a higher calorific value than the nonfuel products, slightly more than 90 percent of the calorific value of US crude oil at the point of production was finally consumed for fuel purposes. On the basis of knowledge of the geology and physical chemistry of crude oils, good support could be adduced for the assumption that the calorific value of the average Soviet crude oil at the point of production closely approximates that of US crude oil, or 1.53 tons of standard fuel per ton. Should Soviet economists, when discussing fuel balances, be evaluating the calorific value of Soviet crude oil at the point of production in terms of the calorific value of the fuel products to be recovered, and should they also anticipate the recovery in fuel form of slightly more than 90 percent of the calorific value of the crude oil at the well head, then a factor of 1.41 (which is 92 percent

* This estimate was derived by a complex methodology, based on many sources, which it would be impractical to reproduce here. The methodology and sources for this estimate are available in CIA files.

of 1.53) appears quite reasonable. Each ton of both Soviet and US crude oil was equated to 1.41 tons of standard fuel in this report for two reasons. First, the 1.41 factor reflects the fuel value of the crude oil, and this fuel value is more important for the purpose of this report than is the theoretical total calorific value of the crude oil at the point of production. Second, the use of the 1.41 factor should make the data presented in this report more readily comparable with other Soviet data on the subject of fuel balances.

APPENDIX E

GAPS IN INTELLIGENCE

Various gaps in intelligence exist concerning the supply of energy in the USSR during 1940-60.

There is a critical need for better data on the calorific value of almost every type of solid fuel being produced in the USSR. There also is a need for information which would indicate the magnitude of production of the following:

1. Hard coal or brown coal produced in the Ukrainian SSR, in the Pechora Basin, and in the Karaganda Basin.

2. Hard coal produced in Novosibirskaya Oblast by mines not under control of the Ministry of the Coal Industry.

3. Anthracite and bituminous coal produced at the various deposits in the Urals.

4. Bituminous coal produced at Noril'sk and lignite produced in Magadanskaya Oblast.

5. Peat produced in the Central Region and in all of the eastern economic regions (VI, VIII, IX, X, XI, and XII).

6. Oil shale produced in Leningradskaya Oblast and in the Volga Region.

7. Fuelwood produced in the USSR as a whole and in each economic region of the USSR.

Better information is also needed concerning the magnitude and the calorific value of each quantity of primary or secondary solid fuel which was included in Soviet foreign trade during 1940, 1945, 1950, and 1955.

Better data are needed on which to base estimates of the magnitude and the calorific value of each quantity of petroleum components and products included in Soviet foreign trade during 1940, 1945, 1950, and

1955. Information is inadequate, moreover, to allow estimates or projections to be made of the following:

1. Total Soviet production of natural gas liquids or the regional distribution of that production in any year since 1939.

2. The regional distribution of Soviet production of natural gas during any year since 1939.

More recent data would also be useful to establish the calorific value of the various Soviet petroleum components and products.

The only gap in intelligence concerning hydroelectric power is that concerning the regional distribution of production of hydroelectric power in the USSR in any recent year.

APPENDIX F

SOURCE REFERENCES

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

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